GUAM AGRICULTURAL EXPERIMENT STATION
ISLAND OF GUAM
Under the supervision of the
UNITED STATES DEPARTMENT OF AGRICULTURE

REPORT OF THE GUAM AGRICULTURAL EXPERIMENT STATION

1930

Issued September, 1931

For sale by the Superintendent of Documents, Washington, D. C. - - - - Price 15 cents

GUAM AGRICULTURAL EXPERIMENT STATION, ISLAND OF GUAM

[Under the supervision of the Office of Experiment Stations, United States Department of Agriculture]

WALTER H. EVANS, *Acting Chief, Office of Experiment Stations*, and *Chief, Division of Insular Stations.*

STATION STAFF

C. W. EDWARDS, *Director.*
JOAQUIN GUERRERO, *Assistant in Agronomy and Horticulture.*
F. B. L. GUERRERO, *Assistant in Poultry Husbandry.*
S. R. VANDENBERG, *Entomologist.*
PETER NELSON, *Assistant.*
A. I. CRUZ, *Assistant in Extension.*[1]

---

[1] Appointment effective Sept. 1, 1929.

GUAM AGRICULTURAL EXPERIMENT STATION
ISLAND OF GUAM, U. S. A.

Under the supervision of the
UNITED STATES DEPARTMENT OF AGRICULTURE

Washington, D. C. ▼ September, 1931

REPORT OF THE GUAM AGRICULTURAL EXPERIMENT STATION, 1930

CONTENTS

REPORT OF THE DIRECTOR

By C. W. Edwards

GENERAL REVIEW

During the year covered by this report experimental activities at the station were mainly a continuation of those begun in previous years. Climatic conditions were less favorable than usual to general crop production. The wet season of heavy rains extended well into the period of ordinarily light rains and retarded preparation of the land for planting, and a late beginning of rains following the dry season delayed the time of planting in the next, or prerainy, season.

In agronomy the results of experiments with different varieties of coarse forages continued to show that Napier and Guatemala grasses are well adapted to nearly all the local fertile soils, whereas Japanese cane is not suited to the upland districts of the northern part of the island. In every instance, Napier grass made the most rapid growth of the eight varieties under test. Japanese lawngrass proved to be superior to either centipede or Bermuda grass for lawn purposes when grown on an upland cascajo soil, especially during the dry season. Of the fiber plants under test, henequen, sisal, and maguey grew well on a rocky limestone hillside.

The growing of leguminous crops is particularly desirable as a means of improving the soil, suppressing weed growth, and preventing soil erosion. The legumes best meeting these requirements during the year included *Tephrosia* spp., kalomu, the Black Mauritius velvet-bean, and seguidillas. The kalomu has only recently been introduced

into Guam and already gives promise of becoming a valuable cover crop. Efforts were continued to determine the varieties of cowpeas that will give the most satisfactory yield of grain for use as a human food and at the same time make a fairly good cover and green-manure crop. Thirteen varieties were under test. Cultural experiments with native varieties of yams showed the advisability of providing the plants with trellises.

Horticultural work was confined principally to the propagation of grafted and budded mangoes, avocados, and citrus for distribution locally, and to the extension and maintenance of the station orchard. A very satisfactory method of grafting the mango was developed, and approximately 1,200 grafted mango seedlings were available for distribution at the close of the year (June 30, 1930). Tests were made to

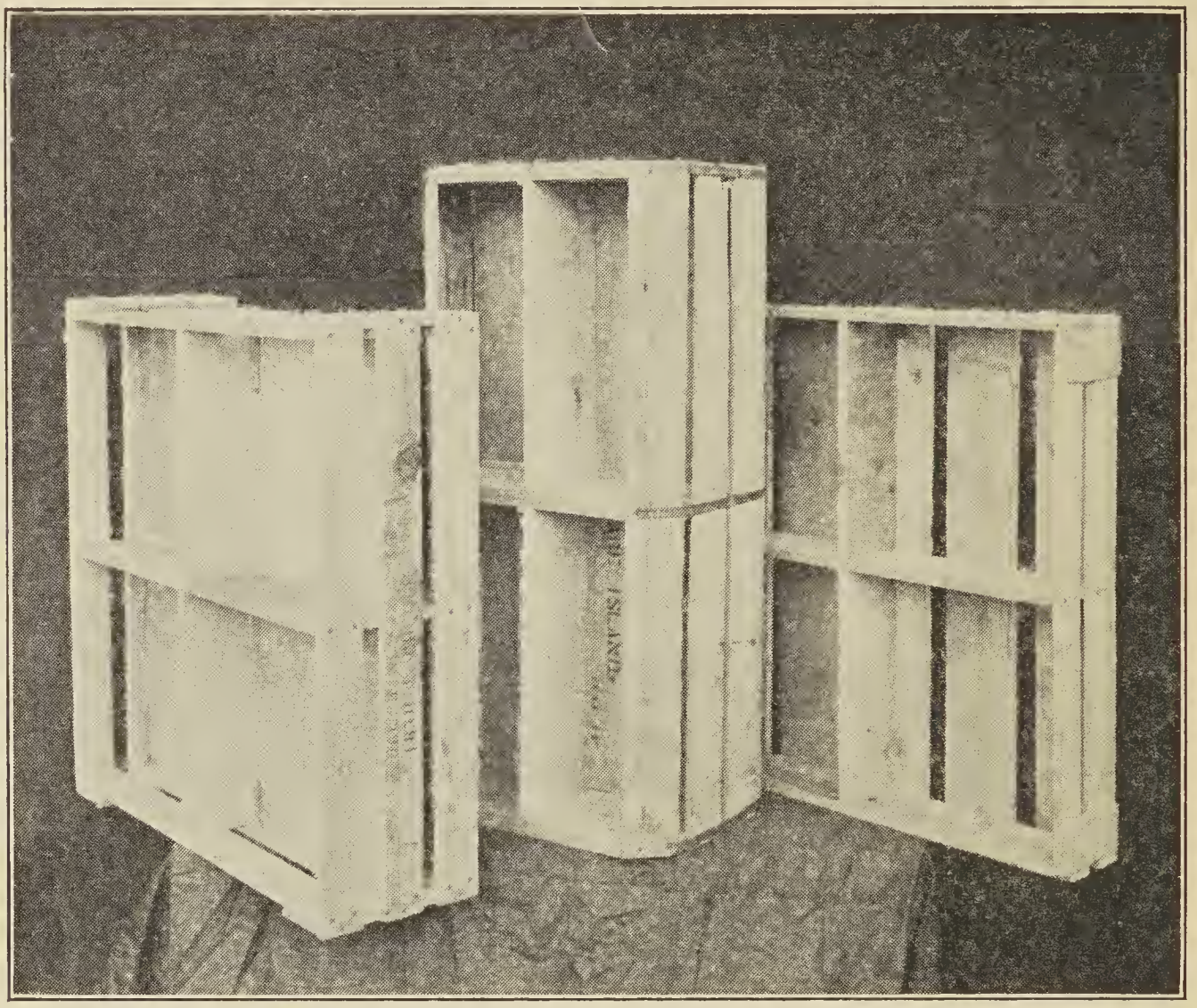

FIGURE 1.—Type of crates used in shipping tests with avocados

learn the most effective method of controlling gummosis and scaly bark, which severely damage the citrus trees of the island. Some benefit was derived from scraping the affected parts of the trees and disinfecting the wounds with bichloride of mercury in alcohol and applying a Bordeaux-mixture paste.

A number of trial shipments of avocados to Manila were made to determine the most efficient methods of packing and handling the fruit. Sound fruits that were carefully picked at the proper stage of maturity, and packed, and stored at a temperature of approximately 40° F. were found to remain in good condition for 16 days. Several kinds of shipping crates and packing material were used in an effort to find those proving best. (Fig. 1.)

Results of pineapple investigations showed that yellowing of the plants on the upland calcareous soils is in most cases due to a deficiency

of available iron in the soil. The condition can usually be remedied by spraying the plants with a solution of iron sulphate.

Previous work at the station has shown to a large extent the various kinds of truck crops that can be successfully grown in Guam. At present efforts are being devoted mainly to a determination of the varieties of these crops best adapted to local conditions. Selective-breeding work with the Cristobal variety of tomato was continued.

Further adaptability tests with various kinds of hardwood were made, and a large number of seedlings were grown in the nursery for distribution. The teak has made very good growth and apparently is well adapted to those fertile soils of the island that are fairly well drained. Mahogany seems to be better adapted to the heavier, deep soils of the lowlands than to the limestone uplands. In a planting of various kinds of trees made last year on savanna land, the talisay (*Terminalia catappa*), the casoy (*Anacardium occidentale*), and the albizzia (*Albizzia lebbek*), are making the best showing.

The general distribution of seeds and plants for the year included a large number of packets of vegetable seeds, many economic plants, propagating material of grain and root crops, seedlings of citrus, mango, avocado, and other fruits, forest trees, and imported bamboo, and rooted cuttings and plants of various ornamentals.

The division of entomology was concerned principally with the work of breeding and distributing parasites of the European corn borer, collecting and distributing parasites of house flies and stable flies, studying and devising methods for controlling local insect pests and diseases of plants, inspecting introduced plant material, and growing some of the introduced plants in quarantine. Efforts to establish the corn-borer parasite (*Exeristes roborator*), continue to be unsuccessful. The house-fly parasite (*Spalangia* sp.), on the other hand, has become well established around the premises of the station, parasitization of the pupae amounting to between 75 and 80 per cent.

In animal husbandry attention was centered on the project having for its objective the establishment of improved station herds of cattle and swine by upgrading the native stock, the development of new breeds of chickens, and the improvement of the local stock generally. The station now has on hand a creditable number of grade Ayrshire cattle, purebred and grade Duroc-Jersey pigs, and purebred and grade White Leghorn chickens. Surplus breeding stock was sold to the public, and privately owned animals were brought to the station for service to the purebred sires. Approximately 704 dozen eggs for hatching were distributed to local poultry raisers.

Results of feeding tests continue to show the value of copra meal as a part ration for all classes of livestock. Farmers are fortunate in being able to obtain an ample supply of this product locally at reasonable cost. A ration composed of 2 parts by weight of cooked breadfruit and 1 part copra meal proved to be better for young pigs than did one composed of 2 parts breadfruit and 1 part fresh coconut. Neither gave as good results as had been obtained with a ration made up of equal parts of breadfruit and copra meal.

Further studies of the matai tati disease, which affects cattle and carabao pasturing on the savannas, show that it can be prevented by feeding the animals bone meal.

Investigations continue to show the widespread prevalence of internal parasites, especially tapeworms and roundworms, among

the poultry of the island. Carbon tetrachloride in coconut oil proved to be the most efficient treatment for roundworms and was also of considerable value for control of tapeworms.

A small increase in the station's appropriation for the year permitted the resumption, at least in part, of extension activities. This work, which proved to be very successful from the beginning in March, 1919, had to be dispensed with early in the fiscal year 1922. The results of the work, even for the short time it was in progress, showed clearly the extent to which it is essential to the agricultural development of the island. In a land like Guam where the native farmer adopts new methods very slowly, agricultural information can be effectively imparted and extensive cooperation secured only through personal contact and by close supervision of work in the field by extension agents. The extension activities cover two general lines: Boys' and

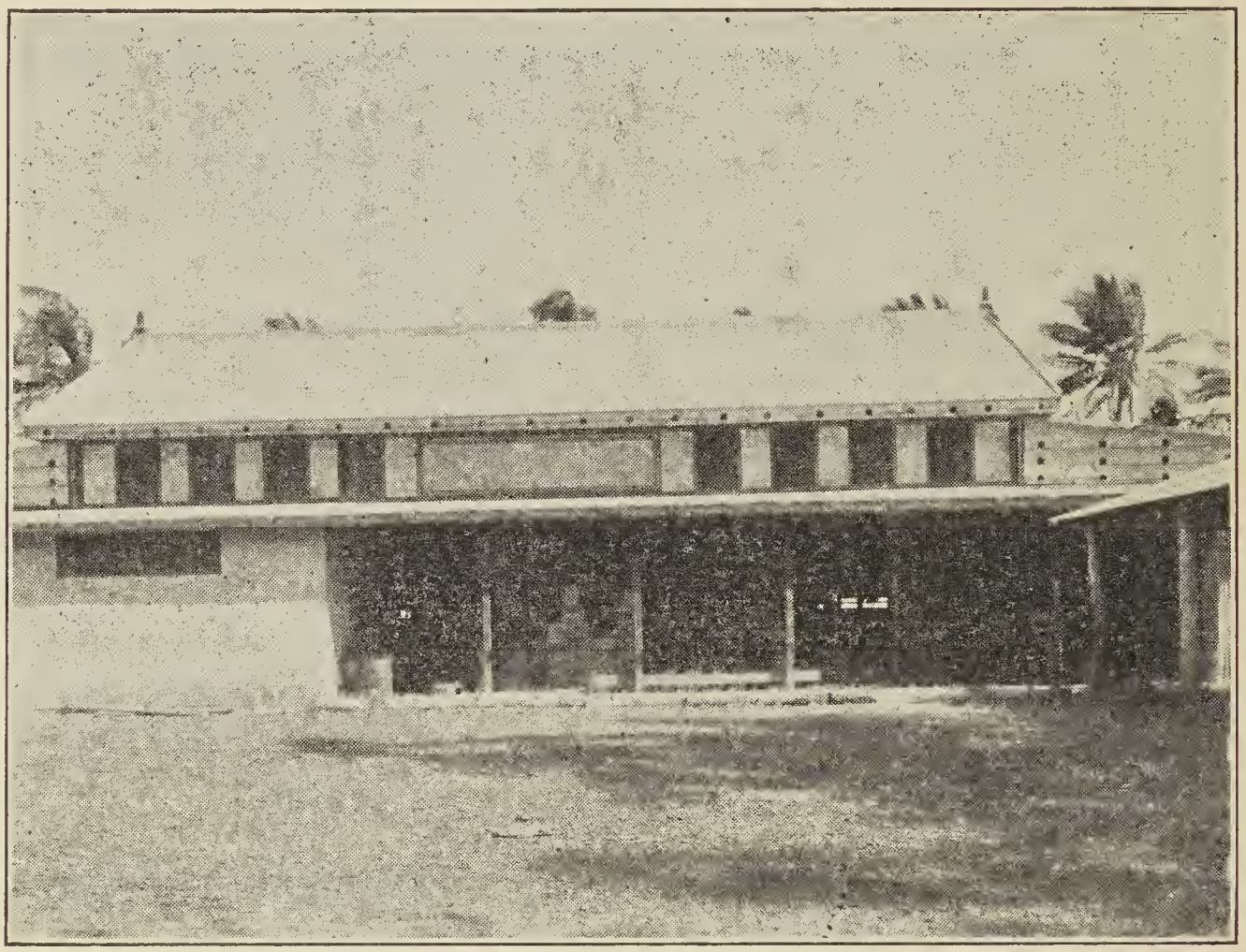

FIGURE 2.—Coconut-oil mill and soap factory

girls' club work and adult demonstrations. The boys' and girls' club work is carried on in cooperation with the local department of public instruction. The club activities supervised during the year included pig, corn, copra, horticulture, root crops, garden, rice, and poultry. The total enrollment in these various clubs was 863 at the close of the year.

Progress on a pineapple plantation in the Barrigada district indicates that the fruit may be successfully grown in certain of the northern plateau districts of the island. Toward the close of the year a canning factory was erected in Agana and equipped with machinery preparatory to handling the first season's pack. The station is cooperating in the development of this work by responding to requests for advice on the selection and preparation of land for pineapple growing and by interesting the native farmer in the pineapple industry. The factory is at present supplying the fruit, but it is hoped that the native farmer

will later grow pineapples as an adjunct crop on his farm to such an extent as to be able to supply fully the needs of the plant.

A new coconut-oil mill and soap factory was established by private interests during the year. (Fig. 2.) The plant occupies a total floor area of 5,508 square feet, and is thoroughly equipped with modern machinery capable of crushing and extracting 6 tons of copra and producing 3 tons of soap in a period of nine hours.

This new factory, like a previously established soap mill, will undoubtedly benefit the agricultural interests. These plants furnish a local market for copra and cause more money to be put into circulation than is the case when the product is marketed elsewhere, and, in addition, they furnish a good and inexpensive feed for livestock in

FIGURE 3.—Grade Ayrshire cow. Still shows some after effects of the matai tati disease

the copra-meal product. They also permit the establishment of a system whereby the fertilizing constituents of the copra can be returned to the local soil. A large amount of plant food is extracted from the soil by the coconut palm and can be restored, at least in part, in the form of manure, through the feeding of coconut meal to livestock.

CATTLE

Feeding test.—The feeding test with grade cows, begun several years ago in a comparison of the value of a local ration and an imported ration, was temporarily discontinued because of the failure of many of the cows to get with calf. The cause of the trouble was not definitely determined.

Matai tati disease.—Results of further investigations of the matai tati disease seem to prove that the trouble in cattle can be prevented by feeding them bone meal. Except in a few instances, it has been

impossible to apply the remedy in the case of carabao because of the reluctance of the affected animals to eat the meal. The matai tati disease is somewhat like the pica disease of cattle in the southern United States and attacks cattle (fig. 3) that are pastured wholly on the savanna (fig. 4), or red-clay uplands of the island. The disease occurs more frequently in cows in milk than in the male animals, young heifers, and dry cows.

SWINE

Feeding test.—Tests were continued in the hope of finding swine rations that will be an improvement over those now in general use and can be fed by the farmer of small means. Combinations of breadfruit, coconut meal, native squash, and fresh coconut were used during the year.

In one test a ration made up of 2 parts by weight of breadfruit of the seedless variety, fed cooked, and 1 part of coconut meal produced

FIGURE 4.—Typical savanna land

better gains in grade pigs 12 weeks old at the beginning of the test than did a ration composed of 2 parts by weight of breadfruit and 1 part of fresh coconut. In both instances, however, the average gains were unusually low. The results indicate that neither of these combinations is satisfactory as a feed for pigs of the age of the animals tested. Much better results were had in previous tests in which a ration composed of equal parts of coconut meal and breadfruit were fed.

In another test, one lot of grade pigs about 5 months of age at the beginning of the test was fed a ration made up of 2 parts by weight of native squash and 1 part coconut meal. A second comparable lot received a combination of 2 parts of squash and 1 part of fresh coconut, and a third lot the squash only. After 15 days the pigs in the third lot had not only failed to make gains, but two of the animals showed a slight loss in weight. This part of the test was therefore immediately discontinued. The other two lots were fed for a period of 60 days. During this time the lot receiving the coconut meal in combination

with the squash made an average daily gain of 0.6 pound per head and the lot receiving the squash and the fresh coconut made an average daily gain of 0.53 pound per head.

REPORT OF THE ASSISTANT IN POULTRY HUSBANDRY

By F. B. Leon Guerrero

Work with chickens was continued along the lines previously reported. An additional laying house was completed during the year and partly fills the need for housing facilities.

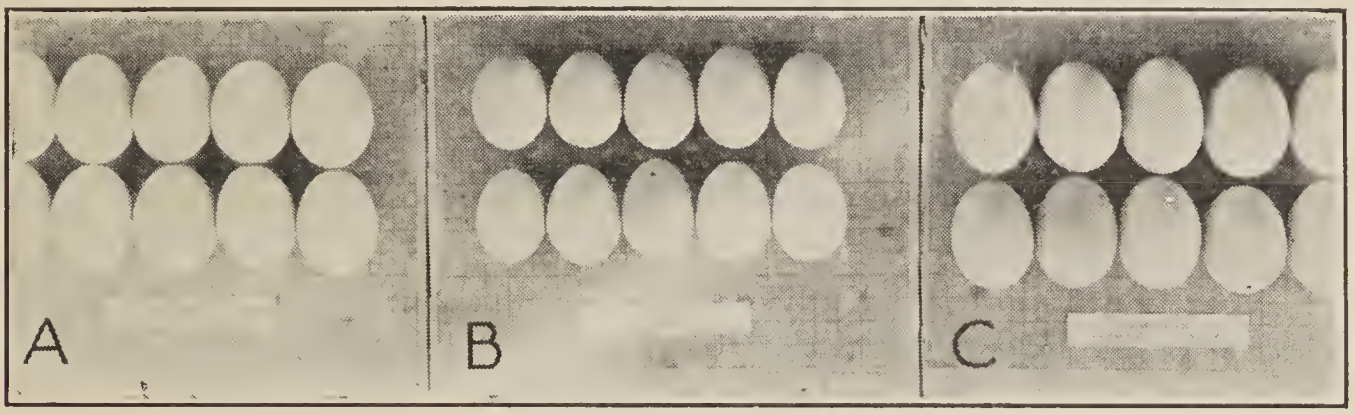

Figure 5.—Eggs produced by the station flock: A, Single Comb Rhode Island Red × Single Comb native white; B, Single Comb native white; C, Single Comb White Leghorn × (Single Comb Rhode Island Red × Single Comb native white)

BREEDING WORK

The work devoted to the development of a new breed of chickens through selective breeding is progressing satisfactorily. Difficulties previously encountered in establishing solid white-plumage and white-egg characters have been considerably reduced by the introduction of a cross of White Leghorns. For the most part, a sufficient number of white-plumaged white-egg laying hens and white-plumaged males can now be secured to fill the station pens. Occasionally an outstanding individual showing other characters is used for breeding. Dark-shelled eggs are rarely laid by the present breeding flocks. Some increase was noted also in the size of the eggs. (Fig. 5.) The eggs are weighed individually, and the average weight is computed at the end of each hatching season. Table 1 gives the average weight in ounces of all the eggs used in each hatching season for the period 1922–1930, inclusive.

Table 1.—*Number and average weight of eggs used in each hatching season for the period 1922–1930, inclusive*

Breed	Eggs used in—																	
	1922		1923		1924		1925		1926		1927		1928		1929		1930	
	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
		Oz.		*Oz.*		*Oz.*		*Oz.*		*Oz.*		*Oz.*		*Oz.*		*Oz.*		*Oz.*
Native	296	1.52	62	1.47	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Rhode Island Red	950	1.77	300	1.74	413	1.72	286	1.79	137	1.82	----	----	----	----	----	----	----	----
White Leghorn	----	----	----	----	----	----	----	----	----	----	342	1.73	900	1.80	1,170	1.69	666	1.83
Rhode Island Red × native	911	1.71	398	1.61	397	1.64	497	1.65	172	1.63	890	1.60	218	1.73	430	1.83	252	1.82
White Leghorn × Rhode Island Red × native	----	----	----	----	----	----	----	----	----	----	----	----	----	----	517	1.75	1,438	1.83

Table 2 gives the average weights of the 10 heaviest and the 10 lightest eggs used in each hatching season for the period 1922–1930, inclusive.

TABLE 2.—*Average weight in ounces of the 10 heaviest and the 10 lightest eggs used in each hatching season for the period 1922–1930, inclusive*

Breed	Heaviest in—								
	1922	1923	1924	1925	1926	1927	1928	1929	1930
Native	1.82	1.60	------	------	------	------	------	------	------
Rhode Island Red	2.33	2.02	2.10	2.13	2.16	------	------	------	------
White Leghorn	------	------	------	------	------	2.11	2.29	2.34	2.28
Rhode Island Red × native	2.10	1.99	1.99	2.00	1.92	2.06	2.15	2.20	2.11
White Leghorn × Rhode Island Red × native	------	------	------	------	------	------	------	2.09	2.35

Breed	Lightest in—								
	1922	1923	1924	1925	1926	1927	1928	1929	1930
Native	1.25	1.34	------	------	------	------	------	------	------
Rhode Island Red	1.49	1.47	1.37	1.46	1.57	------	------	------	------
White Leghorn	------	------	------	------	------	1.43	1.65	1.50	1.49
Rhode Island Red × native	1.37	1.37	1.29	1.37	1.40	1.40	1.47	1.49	1.55
White Leghorn × Rhode Island Red × native	------	------	------	------	------	------	------	1.48	1.47

The egg-weight differences are shown by both the high and the low columns. The difference in weight of eggs from the improved breeds over those from the native hens is rather marked.

DISEASE AND INTESTINAL PARASITE CONTROL

The past year was unusually good for local poultry farmers generally, notwithstanding the occasional outbreaks of poultry diseases in various parts of the island. The local demand for fresh eggs was largely filled from the local supply, and as a result of increasing interest in poultry raising the industry is expanding. Expansion of the industry will likely enhance the disease risk and will necessitate greater activity than ever on the part of the station in solving poultry raisers' problems. That proper management of the flock is the first and most effective step in controlling diseases has been repeatedly demonstrated by the station. It is encouraging to note the progress that is being made along this line.

Another important step in the control of poultry diseases is the eradication of the intestinal parasites affecting them. Experiments with various anthelmintics, including carbon tetrachloride in oil (1 part to 3 parts fresh coconut oil) are being continued. Carbon tetrachloride in oil was again effectively used against roundworms and was of value in controlling tapeworms.

PUBLIC STOCK-IMPROVEMENT WORK

In the work of improving the poultry industry of the island 704 dozen eggs for hatching were distributed to local poultry raisers. The assistant in poultry, working in cooperation with the assistant in extension and the insular extension agent, attended poultry meetings in various farm districts, and in two of the more progressive poultry districts formulated plans for the further development of the industry. The increase in the demand for eggs for hatching purposes gives some idea of the growing local interest in poultry raising.

REPORT OF THE ASSISTANT IN AGRONOMY AND HORTICULTURE

By JOAQUIN GUERRERO

FORAGE CROPS

Tests comparing the adaptability to island conditions of Japanese cane, Napier grass, Guatemala grass, Merker grass, and *Pennisetum setosum* were completed during the year. In the trials which were made at the Piti station on thin uplands underlain by limestone, Napier grass gave the highest average yield per cutting followed by Guatemala grass, Merker grass, *P. setosum*, and Japanese cane, in the order named. These results, together with the results of plantings made at the Barrigada farm, show that Japanese cane is not suited to the upland soils, whereas the other forage crops mentioned do well on both the lowlands and the uplands. Results of the tests are given in Table 3.

TABLE 3.—*Yield per acre in adaptability tests of five coarse forages which were planted November 8, 1924*

Date of cutting	Japanese cane	Napier grass	Guatemala grass	Merker grass	*Pennisetum setosum*
1925	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
July 28	2,080	22,880	15,080	10,920	8,100
November 17	----------	20,930	16,770	15,860	17,700
1926					
March 17	8,970	11,310	5,980	7,540	1,050
September 12	9,620	16,900	18,460	14,040	11,400
1927					
February 1	8,580	24,440	19,760	20,020	6,900
June 18	3,380	17,420	8,580	15,470	5,700
November 19	----------	13,780	21,060	15,730	8,700
1928					
June 21	17,680	14,300	14,300	18,460	3,600
November 9	4,680	9,620	14,300	12,220	5,100
1929					
April 12	2,600	11,050	8,970	8,970	1,500
August 26	2,470	11,700	11,960	8,970	6,450
Average	6,673	15,848	14,111	13,477	6,927

Further studies of the behavior of various coarse forages at the Barrigada farm show that Napier grass continues to produce the highest and Japanese cane the lowest yield. To date (June 30, 1930) some of the plantings have produced six cuttings. The forages under test were planted September 25, 1928, and include Napier grass (*Pennisetum purpureum*), Japanese cane (*Saccharum officinarum*) Guatemala grass (*Tripsacum laxum*), *Pennisetum setosum*, Guinea grass (*Panicum maximum*), molasses grass (*Melinis minutiflora*), jaragua (*Cymbopogon rufus*), Para grass (*Panicum barbinode*), Rhodes grass (*Chloris gayana*), Vasey grass (*Paspalum larranagai*), and *Paspalum dilatatum*.

LAWNGRASSES

In continuation of the work of determining the kind of grasses best suited to the lawns of the island, Bermuda grass (*Capriola dactylon*), Japanese lawngrass (*Osterdamia japonica*), and centipede grass (*Eremochloa ophiuroides*) were planted September 6, 1929, on a clay loam hillside area which had previously received a heavy top-

dressing of ground cascajo. These varieties were grown singly in alternate plats and in plats in alternate rows. During the rainy season the plantings were badly damaged by springtails belonging to the suborder Collembola and by slugs. Spraying with a nicotine preparation, lime-sulphur, and lead arsenate failed to control the springtails satisfactorily. Lime, applied as a spray and in the dry state, was the most effective of any of the materials used in checking the slugs. Of the three grasses, Japanese lawngrass was the least damaged by the pests and made the best growth during the dry season.

In a fertilizer test, conducted on a part of the above-mentioned lawn, coconut meal, nitrate of soda, bone meal, and a mixture containing 3 per cent of nitrogen, 8 per cent of phosphoric acid, and 8 per cent of potash were applied to comparative plats of newly planted Bermuda grass. Despite all efforts to control the springtails and the cutworms attacking the crop, it was too badly damaged to yield results. The decaying coconut meal apparently attracted the pests.

FIBER PLANTS

The fiber plants, including henequen (fig. 6), maguey (fig. 7), and sisal (fig. 8), continue to make luxuriant growth. The henequen plantings, made August 3, 1925, and the maguey plantings, made September 22, 1926, were partly harvested during the latter part of the year in order to determine the amount and quality of fiber they produced. Approximately 8½ pounds of clean, dry fiber, extracted by a rather crude process of crushing and retting, was obtained from 100 leaves of henequen weighing 212 pounds, and 5 pounds from 100 average leaves of maguey weighing 110 pounds. The sisal was planted September 14, 1927. From measurements of the plants in the fiber test plats, taken just previous to this harvest, the sisal leaves were found to have an average length of 39.8 inches and an average width of 3.5 inches, the henequen leaves an average length of 55.53 inches and an average width of 4.62 inches, and the maguey an average length of 55.15 inches and an average width of 4.05 inches.

LEGUMES

Cover-crop efficiency test.—In continuation of the cover-crop project, a planting of legumes consisting of kalomu (*Calopogonium mucunoides*), the Alabama and the Black Mauritius varieties of velvetbeans, seguidillas (*Psophocarpus tetragonolobus*), and *Tephrosia hookeriana* was made in March, 1929. The tephrosia required two cultivations before it effectively suppressed weed growth. The other crops needed four cultivations. Kalomu covered the ground so effectively as to keep down weed and other growth in approximately 122 days from the date of planting, the Alabama velvetbean in 53 days, the seguidillas in 118 days, the Black Mauritius in 83 days, and the *Tephrosia hookeriana* in 319 days. The kalomu continued to suppress weed growth satisfactorily for a period of 298 days, the Alabama velvetbean for 122 days, the seguidillas for 201 days, and the Black Mauritius for 272 days, whereas the tephrosia was still effectively suppressing weed growth at the close of the year.

Cowpea variety test.—Thirteen varieties of cowpeas were under test. The plantings were made December 30, 1929, and harvested March, 1930. The yields generally were low, on account of the drought

prevailing at the time the crop was growing. Sufficient seed material was obtained, however, to permit continuing the test. The variety

FIGURE 6.—Henequen

FIGURE 7.—Maguey

S. P. I. 64017 gave the highest grain yield, followed by the Red Ripper variety. The Potomac variety produced the lowest yield.

ROOT CROPS

Sweetpotatoes (*Ipomœa batatas*).—In continuation of the work under the sweetpotato project, eight introduced and three native varieties of sweetpotatoes were planted October 5, 1929. The plants grew well until the drought set in, when they weakened and failed to produce. The work is to be repeated.

Yams (*Dioscorea* spp.).—The yam planting of January 3, 1929, was harvested January 9, 1930. As was the case last year, the trellised plats produced a much higher yield than the plats not provided with supports. The acre-rate yields are given in Table 4 and the varieties are illustrated in Figures 9 to 16, inclusive.

FIGURE 8.—Sisal

TABLE 4.—*Effect of trellising on acre yield of yams which were planted January 3, 1929, and harvested January 9, 1930*

Variety	Yield of yams grown—		Variety	Yield of yams grown—	
	On trellis	Without trellis		On trellis	Without trellis
	Pounds	*Pounds*		*Pounds*	*Pounds*
Dioscorea latifolia	7,035	1,610	Dagon Jaya	12,880	4,845
Dioscorea alata	16,212	8,470	Dagon Nika	14,520	5,022
Dagon Agaga	30,800	8,442	Dagon Gado	11,360	3,015
Dagon Apaca	20,570	13,450	Dagon Sumay	18,360	7,700

FRUIT INVESTIGATIONS

Pineapples.—During the year the attention of the station was directed to a yellowing of practically all the pineapple plants growing in the fields of the local pineapple corporation. A small plat containing two rows of the most severely affected plants was selected for study. One row was treated with ammonium sulphate, applied

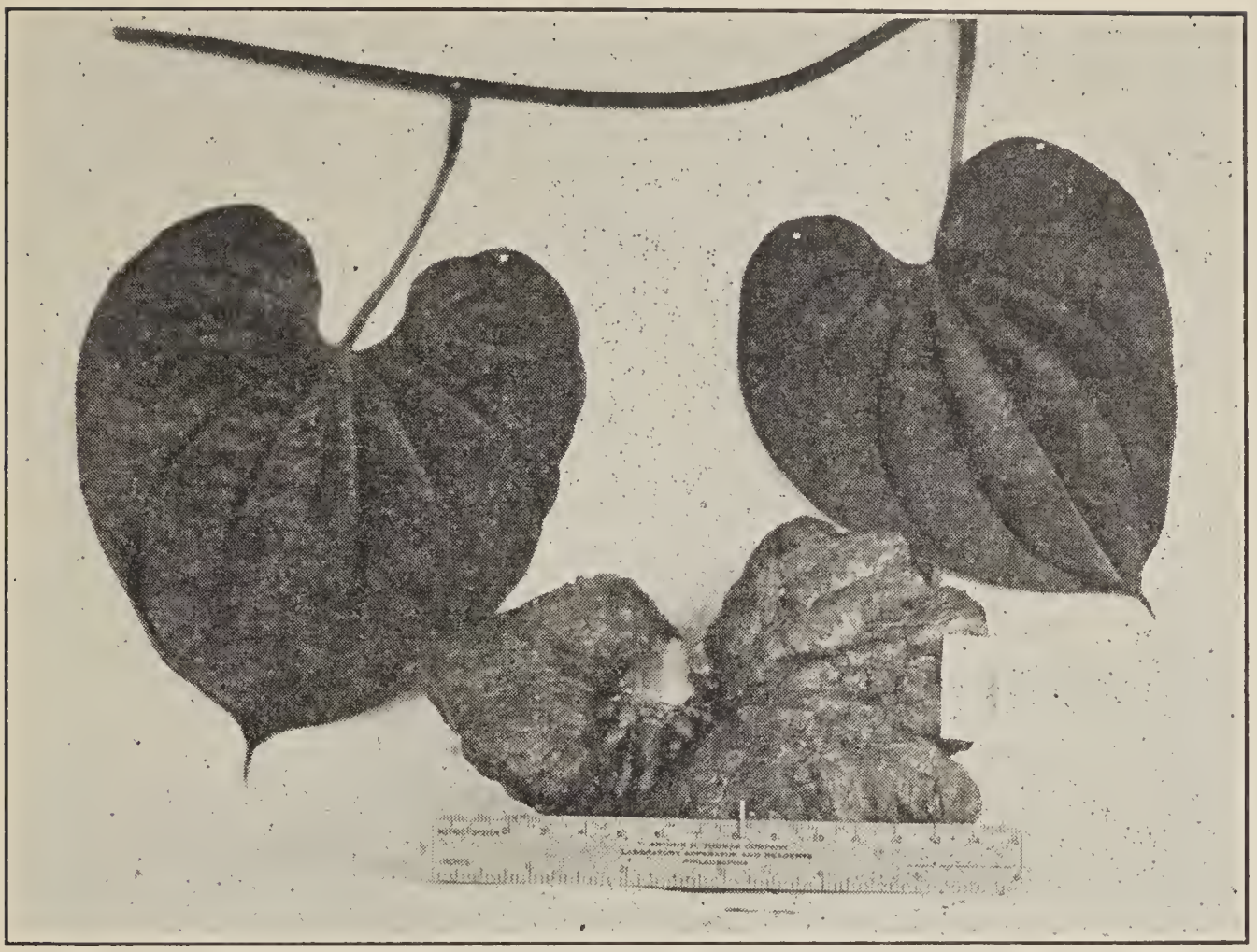

FIGURE 9.—Yam (*Dioscorea latifolia*)

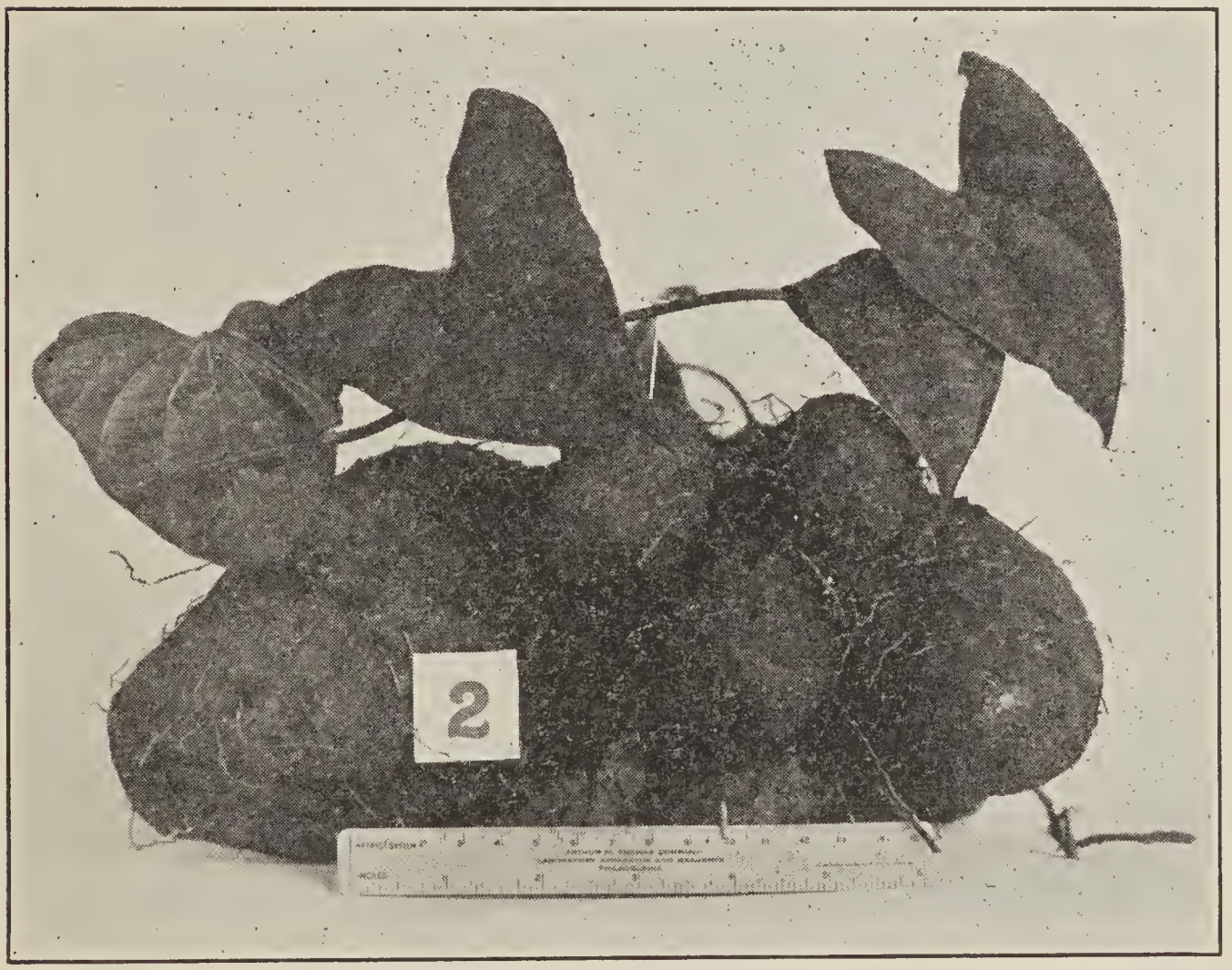

FIGURE 10.—Yam (*Dioscorea alata*)

as a spray to both tops and roots, and the other was sprayed with a 6 per cent solution of iron sulphate once a week for five consecutive weeks. Plants receiving the ammonium sulphate apparently failed to benefit, whereas those sprayed with the iron sulphate solution began to turn green at the end of the third treatment and were normal in color after receiving the fifth treatment. The spraying treatment gave such immediate results in the small plat as to cause the corporation to decide to treat the whole plantation. A new supply of the chemical in quantity sufficient to spray the field at least four times

FIGURE 11.—Red variety of yam, Dagon Agaga

was received from Hawaii through the instrumentality of the Hawaii Agricultural Experiment Station. The new material for use was reduced in strength to 5 per cent. After receiving the first treatment the yellow plants throughout the field began to improve rapidly, and after receiving the third treatment they were apparently restored to normal condition.

Avocados and mangoes.—In continuation of the work of producing grafted avocados and mangoes for local distribution, various methods of propagating the trees were compared. Of the several methods

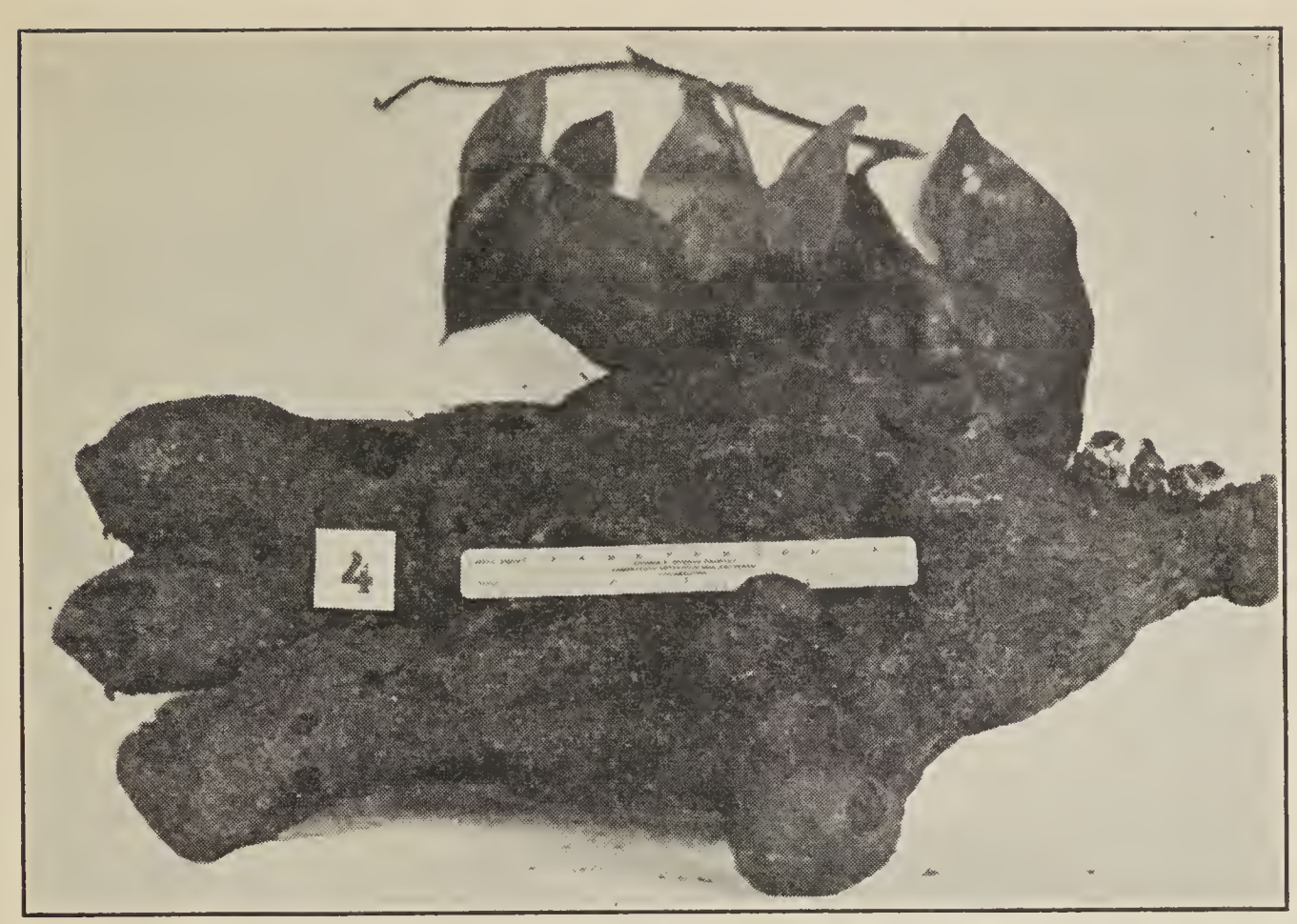

FIGURE 12.—White variety of yam, Dagon Apaca

FIGURE 13.—Dagon Jaya variety of yam

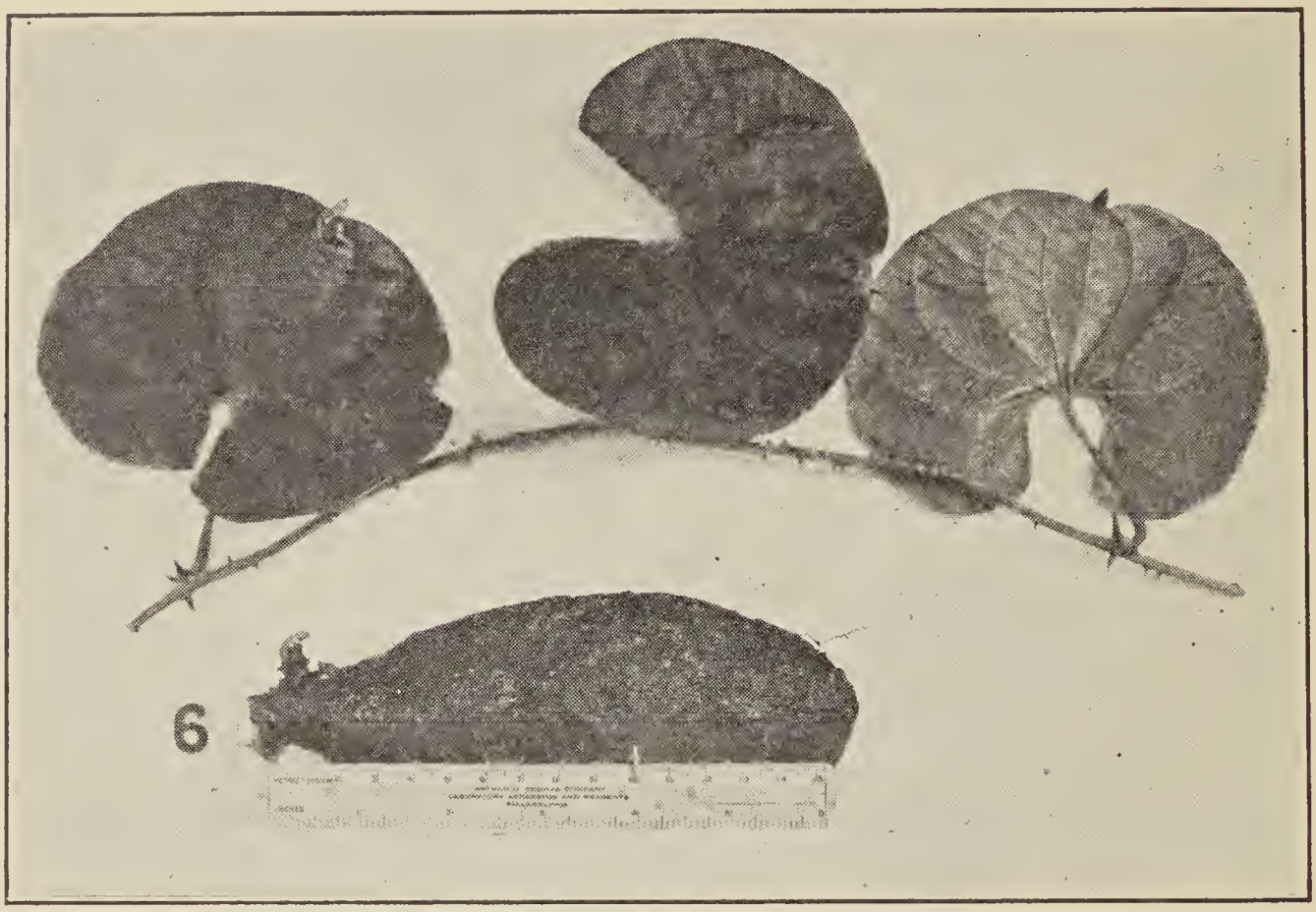

FIGURE 14.—Dagon Nika variety of yam

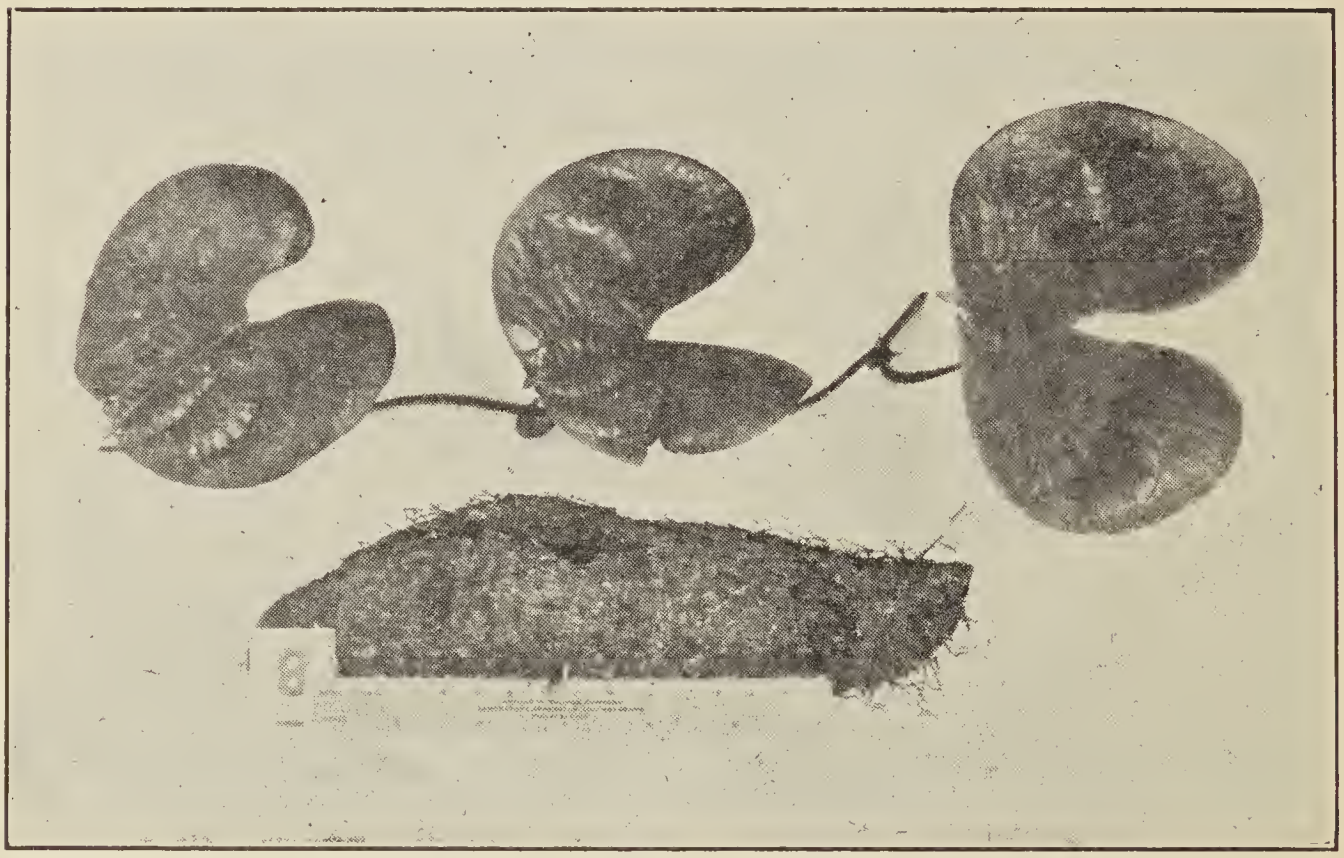

FIGURE 15.—Dagon Gado variety of yam

tried a modified side-graft gave the best results, especially with the mangoes which were grafted during the rainy season. (Fig. 17.) In this method the graft was placed and secured in the usual manner and paraffined. To form a receptacle for sphagnum moss, a piece of corrugated cardboard a few inches wide was placed about the union and secured at the lower edge. (Fig. 18.) The receptacle was loosely filled with sphagnum moss and kept moist. The cardboard and moss were not removed until growth of the scion showed that union had taken place. At this time the stock was girdled just above the point of union and then removed altogether about one week later. (Fig.

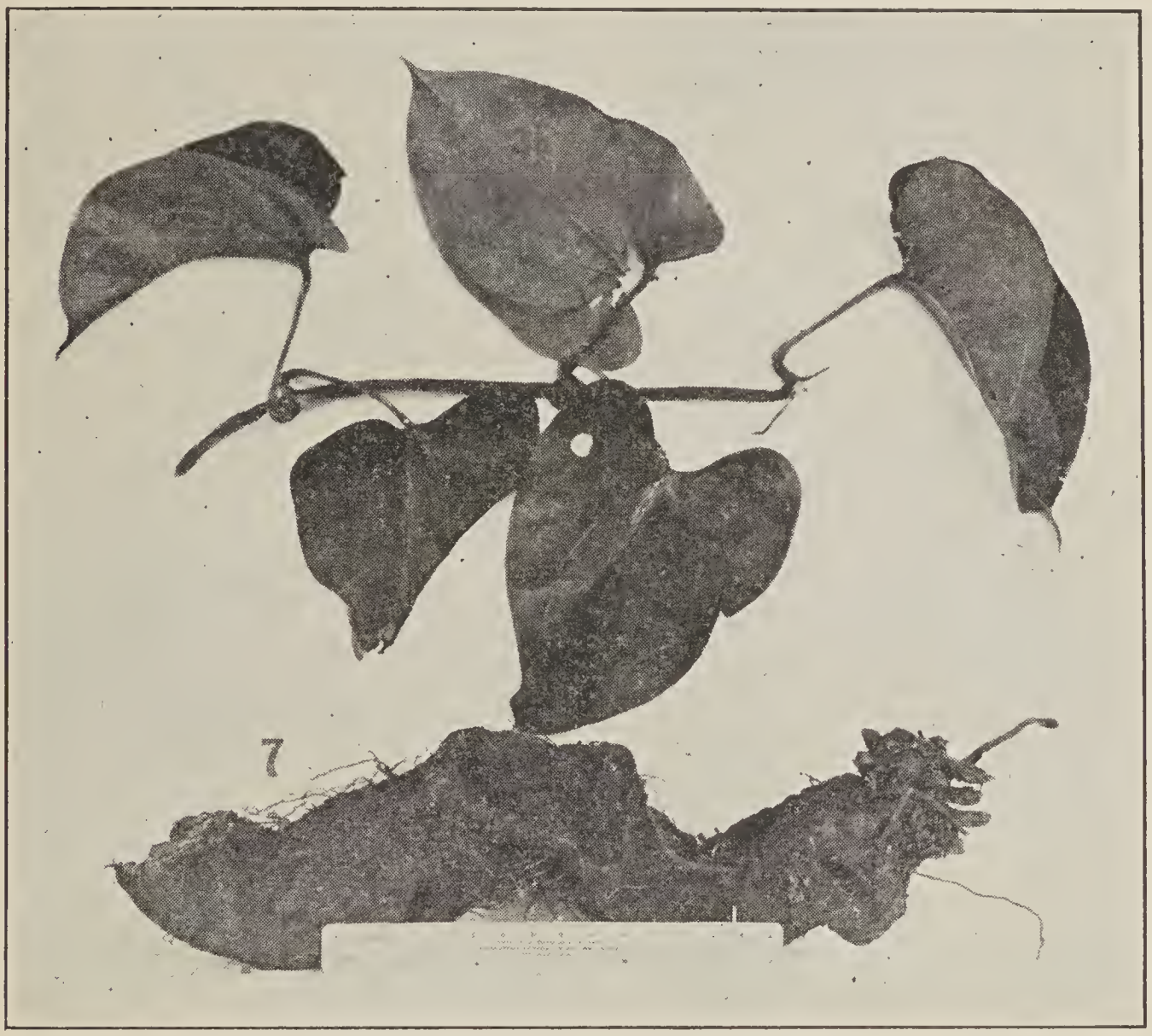

FIGURE 16.—Dagon Sumay variety of yam

19.) Apparently the cardboard and moss protected the union against harm from the heat of the sun. It has been observed at the station that tender plants present the appearance of having been scalded after they have been exposed to the hot, between-shower, periods of sunshine which are of frequent occurrence during the rainy season. The practice of leaving the crown or top of the root stock intact until after union of scion and stock has taken place gave better results than were obtained by removing the crown at once following the grafting operation.

Nursery.—Work in the nursery was seriously handicapped by the presence of beetles (*Phytorus pinguis*) which devoured the young shoots of various seedlings. Damage was materially reduced by spraying the young plants with a combination of lead arsenate and lime.

Bananas.—In continuation of an experiment begun last year for study of the productiveness of all the different varieties of bananas and plantains now found growing on the island and for production of propagating material for local distribution, three varieties of plantains and five varieties of bananas were planted. The plantings will be extended from time to time as material from various sources becomes available.

FORESTRY

At the close of the year data were collected relative to the growth of various plantings of teak made some years ago in various parts of

FIGURE 17.—Method of side-grafting mangoes: A, Preparation of the scion; B, graft tied and paraffined

the island. Of the plantings set out five years ago, 70 seedlings on a deep friable clay loam in the Yona district were found to average 25 feet in height and 5 inches in diameter of trunk; 504 seedlings on fairly heavy clay river-bottom land in the Yona district averaged 35 feet in height and 6 inches in diameter; 336 seedlings on a rocky hillside of rather poor, thin clay loam averaged 15 feet in height and 4 inches in diameter; and 20 seedlings on a thin clay loam underlain with limestone in the Barrigada district averaged 24 feet in height and 3.5 inches in diameter. Of the plantings set out three years ago, 24 seedlings on a rich river-bottom land averaged 27.5 feet in height and 4.75 inches in diameter.

Mahogany seedlings set out four years ago on an area of land that for many years previously had been covered with a heavy growth of tañgantañgan (*Leucæna glauca*) (fig. 20), averaged 11 feet in height and 2.5 inches in diameter, while similar seedlings set out at the same time on an adjoining area where only native grasses had grown previously averaged only 5.33 feet in height and an inch in diameter.

FIGURE 18.—Method of side-grafting mangoes. Graft wrapped in corrugated board

Seedlings of casoy (*Anacardium occidentale*), talisay (*Terminalia catappa*), albizzia (*Albizzia lebbek*), mahogany (*Swietenia mahagoni*) (fig. 21), gago (*Casuarina equisetifolia*), pili nut (*Canarium ovatum*), *Aleurites trisperma*, and algaroba (*Prosopis juliflora*), which were set on a typical red clay upland area of very poor fertility last year in order to determine the possibility of growing certain economic trees on the otherwise wasted savanna lands (fig. 4), made only fair growth during the year.

BAMBOO

Since bamboo has a principal rôle in the economic development of the peoples of the Tropics, the station introduced through the United States Department of Agriculture three kinds (*Bambos tulda, B. polymorpha,* and *Dendrocalamus strictus*) for trial. Efforts will be made to learn which kind of bamboo is best suited foı building and other purposes. Of the three kinds under test *B. polymorpha* and *D. strictus* are making good growth.

FIGURE 19.—Method of side-grafting mangoes. Union completed

GARDEN-VEGETABLE DEMONSTRATIONS

Bean variety test.—During the year 4 bush and 6 pole varieties of Lima beans and 11 bush and 7 pole varieties of string beans were under test to determine those best adapted to local conditions. The planting was made December 13, 1929, and harvested in January and in May, 1930. Unfavorable weather conditions prevailing during the growing season resulted in rather low yields. The acre-rate yields were as follows:

	Pounds
Bush Lima varieties:	
Jackson Wonder	5, 062. 50
Henderson	3, 740. 63
Burpee Improved	3, 178. 13
Fordhook	1, 490. 63
Pole Lima varieties:	
Yopp	2, 503. 13
Small white or butter beans	2, 390. 63
Red beans from the Virgin Islands	1, 406. 25
Small white beans from the Virgin Islands	1, 237. 50
Florida butter	731. 25
Large white Limas	450. 00
Bush string varieties:	
Bountiful	4, 359. 38
Wardwell's Kidney Wax	2, 615. 63
Tennessee Green Pod	1, 968. 75
Giant Stringless Green Pod	1, 350. 00
Bush string varieties—Con.	
Improved Round Refugee	1, 040. 63
Stringless Green Pod	618. 75
Excelsior Refugee	393. 75
Rust Proof Golden Wax	365. 63
Red Valentine	225. 00
Sure Crop Stringless Wax	196. 88
Prolific Black Wax	140. 63
Pole string varieties:	
Short frijole	3, 796. 75
New McCaslan	3, 628. 13
Genuine Cornfield	2, 615. 63
Kentucky Wonder Wax	1, 828. 13
White Cornfield	1, 406. 25
Georgia Monstrous	900. 00
Kentucky Wonder	168. 75
A dry navy bean, Early Wonder	984. 38

FIGURE 20.—Tañgantañgan thicket

Cabbage variety test.—Fifteen varieties of cabbage were planted December 13, 1929. The plants did well until the advent of the drought when they made stunted growth and failed to head.

Tomatoes.—In continuation of the selective breeding work with tomatoes begun to determine the variety best suited to local conditions a planting of five varieties was made during the year. Of these, Marglobe continued to give the best results, and Norduke produced no marketable fruits. The acre-rate yields were as follows: Marglobe, 1,137.5 pounds; Louisiana Pink, 811.6 pounds; Saipan, 276.8 pounds;

and Norton, 177.2 pounds. Selection work with the Cristobal variety showed very little improvement over that of last year. Notwithstanding the fact that nearly all the plants were stunted by the drought, a fairly good quantity of seed was obtained from apparently

FIGURE 21.—Mahogany seedling (*Swietenia mahagoni*) planted on highland

normal vines for further work. Throw-back characteristics were apparent in many of the fruits of the F_5 hybrid tomatoes. Selection work has failed to improve the breed and even to maintain the size of the fruit.

SEED AND PLANT DISTRIBUTION

During the year the general distribution included:

Henequen	bulbils	180	Casoy	seedlings	2
Grape (rooted)	cuttings	15	Bamboo	do	26
Sweetpotato	do	2,000	Seeded breadfruit	do	105
Sugarcane	do	20	Rubber	do	6
Ornamentals (rooted)	do	2,099	Daok	do	192
Vegetable seeds	packets	111	Teak	do	105
Mahogany seed	packet	1	Marcottaged lemon	do	66
Sorghum	packets	28	Lemon	do	130
Tobacco seed	do	7	Orange	do	151
Ceriman	plants	6	Rose-apple	do	11
Eggplants	do	150	Aberia	do	12
Mangoes (grafted)	do	17	Mabolo	do	77
Avocados (grafted)	do	138	Santol	do	8
Edible canna	do	44	Marcottaged star-apple	do	6
Pepper	do	469	Mangosteen	do	2
Papaya	do	334	Pili seedlings	do	29
Tomato	do	589	Baguilumbang	do	53
Cabbage	do	1,770	Tangerine	do	90
Lettuce	do	100	Kapok	do	870
Velvetbeans	pounds	21	Marcottaged chico	do	10
Cowpeas	do	5	Talisay	do	10
Centipede grass	sacks	9	Pineapple	suckers	46
Bermuda grass	sack	1	Banana	do	31
Breadfruit	seedlings	5			

REPORT OF THE ENTOMOLOGIST

By S. R. Vandenberg

From an entomological standpoint the year was generally favorable. Insect depredations were largely confined to the European corn borer (*Pyrausta nubilalis*) which has become rather widespread in the island.

EUROPEAN CORN-BORER PARASITES

The work of breeding the European corn-borer parasite (*Exeristes roborator*) for distribution was continued in cooperation with the Bureau of Entomology, United States Department of Agriculture, notwithstanding the fact it seems to be of doubtful value. So far there is no conclusive evidence to show that the parasite is at work in the fields. Probably only half a dozen parasites have been recovered. An introduction of the tachinid fly (*Masicera senilis*) has therefore been requested for trial on the island. Breeding work with parasites was handicapped by reason of the scarcity of growing corn since January and the resultant scarcity of borers for use as hosts. During an abnormally long, dry season corn unfortunately was grown only in small isolated places, and the availability of borers from these areas was not sufficient to permit breeding operations at the station.

The general scarcity of host material led to investigations regarding the possibility of keeping the parasitic eggs in cold storage for use when the host material would be abundant. A metal ice box in which the temperature registered between 65° and 67° F. was used in the first attempts to store the eggs. This temperature did not affect hatchability. In another test, the same ice box was insulated with wood surrounded with a dead-air space to lower the temperature in the ice box to between 48° and 50°. Table 5 gives the results of the test.

REPORT OF THE ASSISTANT IN EXTENSION

By A. I. Cruz

A department of the station devoted especially to extension work was reestablished during the year. The assistant in charge was appointed September 1, 1929, but did not arrive to assume active duty until October 20, the greater part of the intervening time being spent in Honolulu in a study of extension activities there. Previous work along this line had been very successful from its beginning in March, 1919, until it was discontinued early in the fiscal year 1922 because of a reduction in the station's appropriations. The filling of this position meets an urgent need of the station. Extension work in Guam presents many problems not encountered in other countries. The people in general are reluctant to visit the station, and agricultural information and instruction can therefore be properly placed before them only through contact with them in the field.

The work is being carried on along two general lines at present. Adult demonstration work is concerned with those who are concentrating their attention principally upon improved methods of managing their farms. The younger generation, who will be the farmers of to-morrow, is being interested in the boys' and girls' club work and in gardening activities maintained in connection with each of the schools of the island. The boys' and girls' club work is very popular.

ADULT DEMONSTRATION WORK

Under this phase of extension work the older ranchers are instructed through lectures and demonstrations in the use of improved farming methods and farm implements and are advised to provide themselves with purebred and high-grade animals for breeding purposes. The island government extension agent and the district commissioners are generously cooperating with the station in an effort to make the adult demonstration work a success. Satisfactory progress was made in the construction of plant houses in the outlying districts for use in training the farmers of each district in correct methods of propagating plants. Demonstrations were given in budding and grafting fruit trees and in the use of proper methods for growing vegetables. Demonstrations were also given of the best methods of pruning citrus trees and of treating them for gummosis control.

Demonstrations on the general care and management of livestock were given more particularly to farmers in the northern half of the island. Emphasis was laid especially on cleanliness and proper feeding, and the care of sick animals. Five cases of hog cholera and nearly 50 cases of chicken pox and roup were brought to the attention of the extension division for treatment. Colds, intestinal worms, and limber neck in poultry also received attention. Ranchers having sick fowls were urged to attend the demonstrations of methods of treating affected poultry in order that they might be able to apply the methods promptly themselves.

A demonstration in plowing a field with an improved type of implement was given to a few of the more interested and progressive farmers in the Yona district. This demonstration and the work of constructing a plant house were supervised by the district patrolman. Further plowing demonstrations will be given as time permits.

BOYS' AND GIRLS' CLUB WORK

Boys' and girls' agricultural clubs were organized in the outlying districts and in certain of the Agana school districts where the pupils and other children as well as adults are able to carry on club projects at home. The clubs as reorganized are again under the supervision of the station cooperating with the local department of education. Any boy or girl under 20 years of age may become a club member provided that he or she is willing to follow instructions furnished by the assistant having charge of the clubs.

The boys' and girls' clubs are being reorganized principally (1) to instruct the young people in the principles of modern agriculture by having them do definite lines of work at home under supervision, (2) to bring the school life of the boys and girls in closer contact with the home life, (3) to provide an organized means of enabling them to become better citizens by training them along lines of work useful to the community in which they live, (5) to furnish an organized means of permanently improving agriculture in the island, and (5) to enlarge the vision of the boys and girls by putting them in touch with what is being done in other places.

The following rules have been drawn up for the club work:

Each club member must enroll in some definite line of work.

He must own the material he produces or grows. This rule must be obeyed.

He must do his club work in accordance with instructions and in a businesslike manner.

He must keep a careful record of all expenses involved in carrying out his work.

He must exhibit his material wherever and whenever directed to do so by the club leader.

He must finish his club work, and furnish achievement records to the club leader in charge, signed by proper witnesses, upon the completion of the club project.

He must give to the club leader at the end of each season a story, in writing, of the work he has done in connection with his project.

Of the 863 members enrolled, beginning October, 1929, 465 turned in satisfactory reports.

The club activities supervised during the year included rice, corn, horticulture, pigs, root crops, gardening, copra, and poultry. Members of the rice club are instructed in modern methods of raising the crop and are urged to lay by a surplus for use in emergency. Poultry-club members are encouraged to raise chickens, and to some extent turkeys and ducks, of an improved breed, and they receive instructions on the selection and care of eggs for hatching, and on proper methods of feeding and caring for the flock. Members of the horticultural club receive instruction on proper methods of propagating plants and caring for fruit trees. Members of the corn club are instructed in improved methods of producing the crop and are advised to save selected seed for the next season. Members of the pig club are required to raise at least one pig according to improved methods. The native method is to keep the pig tied to a tree, or stake, by a short rope secured to the foreleg. Members of the root-crop club are taught the importance of raising increased areas of the more important locally grown root crops for home consumption, as well as the kinds of crops best adapted to their respective districts. Members of the garden club are concerned principally with improved methods of planting, cultivating, and harvesting vegetables. These gardens serve as demonstrations to the people of the district in which

they are conducted. Members of the copra club are taught proper methods of caring for the coconut tree, growing cover crops, gathering and storing the nuts, and making copra.

LOCAL CLUB ORGANIZATION

All the club members residing in a given district are grouped into one organization, regardless of the club activity pursued by them. The assistant in extension, acting upon the advice of the superintendent of schools, appoints club supervisors, each of whom is responsible for the work in his district and holds meetings of the local clubs when necessary. At these meetings the club members submit reports on the work in progress. The supervisor keeps a record of the work done by each member, reports on the progress of club activities in his district, and issues to club members printed instructions in the form of leaflets. Usually the supervisor and all the members of his local club visit each boy's or girl's demonstration. Once a month the district club supervisors attend the meetings held by the teachers in Guam. Problems are then presented for discussion, and suggestions are offered for solving them. This enables each supervisor to know what the other is doing and to receive instructions for improving his work. Table 7 gives the enrollment by districts and by activities for the season ended December 15, 1929.

TABLE 7.—*Enrollment of boys' and girls' clubs, December 15, 1929*

District	Project and number of members enrolled								
	Rice	Poultry	Horticulture	Corn	Pig	Root crop	Garden	Copra	Total
Barrigada		13	3	13					29
Aniguac		30	5	10	18	20	56		139
Asan		5	6	7	10	3	4		35
Talofofo				14		4		19	37
Piti	1	15	15	16		12	18	1	78
Sinajana		20	10	1	1	3	20		55
San Antonio		54		18		7	20	16	115
Intermediate		22						28	50
Umatac		3	4	6	10	19	18	6	66
Sumay		12		6		3	30		51
Merizo		28	3	5		5	16	3	60
Price		31		10		2	3		46
Yona		14	2	4		3	6	3	32
Inarajan		30	6		8		20	4	68
Dededo		5		2		1	6		14
Total	1	282	54	112	47	82	217	80	875

METEOROLOGICAL OBSERVATIONS, 1929–30

Observations made at the station on temperature, precipitation, and wind during the fiscal year ended June 30, 1930, are summarized in Table 8.

TABLE 8.—*Condensed meteorological observations for the year ended June 30, 1930*

Month	Temperature					Total precipitation	Prevailing direction of the wind
	Maximum	Minimum	Mean maximum	Mean minimum	Monthly mean		
1929	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	*Inches*	
July	87.5	72.5	84.37	75.44	79.91	18.30	Southeast.
August	88.0	73.0	85.93	75.88	80.91	7.48	Do.
September	88.5	73.5	85.50	75.86	80.68	18.07	Northeast.
October	89.0	71.0	86.43	76.03	81.23	9.39	East-northeast.
November	89.5	72.5	86.62	76.24	81.43	10.99	East.
December	89.0	70.0	86.28	75.42	80.85	5.26	Northeast.
1930							
January	89.0	70.0	85.29	74.23	79.76	5.40	East.
February	89.0	67.0	86.40	73.72	80.06	0.60	Northeast.
March	89.0	71.5	87.18	74.03	80.60	0.99	Do.
April	89.0	72.0	86.66	74.57	80.61	1.53	East.
May	88.5	73.5	85.06	76.50	80.78	4.49	Northeast.
June	87.0	72.5	85.02	76.10	80.56	6.49	Southeast.
Total						88.99	

U. S. GOVERNMENT PRINTING OFFICE: 1931